

## CONTRIBUTIONS TO A KNOWLEDGE OF THE CRAMBINAE. II.

### *Crambus laqueatellus* Clemens.

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*Crambus laqueatellus* is one of the largest and most beautifully marked species in this genus and is easily distinguished from all other North American forms by the two parallel silver stripes running almost the full length of the fore wing. (Fig. II, 6).

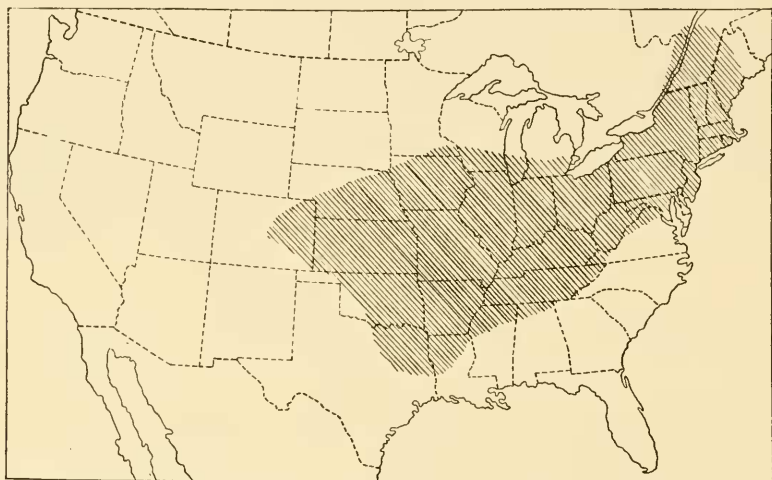
#### SYSTEMATIC HISTORY.

*Crambus laqueatellus* was first described by Clemens in 1860. Walker redescribed it in 1863 from specimens from "North America" as *C. semifusellus*, a name reduced to synonymy in 1891 by Smith. Aside from its inclusion in various lists and the few references to it as an economic species its literature is meager. Fernald (1896) and Holland (1903) both figure the moth in colors. Nothing has ever been written about any stages other than the adult, except Felt's (1894) description of the egg and first stage larva. In other respects also his notes are hitherto the most extensive of any relating to this species.

#### DISTRIBUTION.

It is a North American species and occurs throughout a section of the United States extending from Maine to Texas and from Louisiana and Tennessee on the south to Colorado and southern Minnesota on the north. The writer has seen specimens from nearly every state within this area. The Texas record is based on Zeller (1872) who received specimens, presumably from Bosque County, collected by Boll. Fyles (1896) records it from Montreal and Quebec, Zeller (1863), Lintner (1874) and Felt (1894) list it from New York State, and Fernald (1896) from Maine and Louisiana. As indicated by Fyles' records, the species extends somewhat into Canada, but it does not appear in Allen's (1918) list of Nova Scotian

*Crambinae*. The shaded portion of the accompanying map (Fig. I) indicates at a glance the territory from which *laqueatellus* has been reported but more extensive collections will likely somewhat extend these limits.



Map showing known distribution of *Crambus laqueatellus clem*

FIG. I.

#### SEASONAL HISTORY.

*Crambus laqueatellus* has one distinct generation annually. In Tennessee, where the appearance of the moths has been closely watched for several years, the period during which they have been found in the field extends from April 24 to May 31. Farther north they appear correspondingly later. Felt (1894) states that this is the earliest species to appear in New York State and that at Ithaca it has a compact breeding season of about five weeks. His trap light record for 1889 shows that at Ithaca specimens were taken from May 26 to June 17. According to Webster (1896) moths were abundant in northern Ohio in 1881 from May 29 to June 17. At Columbus, Ohio, Hine (1897) records the moths as present the latter part of April and through May. In Smith's (1900) New Jersey list the species is recorded for May, June and August. August is included on the basis of a single moth taken on the 31st. This record and one by Gillette (1898) mentioning the capture

of a specimen at light at Denver, Colo., on August 16, seem to indicate that there is a slight tendency toward a second generation. This is corroborated by the results of our rearing experiments, reported in more detail later, where moths matured in September from eggs laid the previous May. In general, however, it may be assumed that there is but a single annual generation, the period during which the moths are present in any given locality covering about five weeks. The following table gives the dates within which the moths have been recorded in the respective states.

Illinois—May 14–May 28.  
Iowa—June 6–June 16.  
Kentucky—May 23–June 21.  
Maryland—May 8–May 28.  
Michigan—June 6–June 14.  
Minnesota—June 6.  
New Hampshire—June 2.

New Jersey—May 18–June 24.  
New York—May 20–June 24.  
Ohio—June 9.  
Pennsylvania—June 14–June 30.  
Tennessee—April 24–May 31.  
Wisconsin—June 15.  
District of Columbia—May 20.

This list is very incomplete, but will serve as a starting point for further observations.

The larvæ have never been taken in the field and nothing is known of their seasonal habits. Judging from others of this genus it may be predicted that the larvæ feed and grow during the late spring and summer, reach their growth by the end of the summer season and then remain quiescent in their cocoons during the winter, pupating ten days or two weeks before their emergence in the spring. Whether they feed at all in the spring or complete their growth in the fall is a fact that will have to be ascertained by further studies.

#### ECONOMIC HISTORY.

Unless further observations bring to light something entirely new in the economy of this species, it must be listed as of little or no economic importance. It has once been charged with injury but it seems certain that it was a case of mistaken identity or bad companions. F. M. Webster (1896) found the moths abundant in association with those of *Crambus trisectus* and *C. mutabilis* a short time after crambid larvæ had devastated fields of grass and small grain in northern Ohio in 1896. While *laqueatellus* larvæ, if present in numbers, might somewhat intensify the damage in such a case, it is very much more probable that the injury should be laid to the other two species,

both of which have repeatedly proved themselves capable of becoming pests of considerable importance. No adults were reared directly from the larvæ which caused the Ohio damage. Runner (1914) lists this species as of economic importance, but apparently bases his statement on the foregoing record and furnishes no additional evidence. Felt (1906) also blackens its character on the same flimsy basis, but until new evidence can be produced the verdict must be "not guilty."

#### HABITS OF THE MOTHS.

In Tennessee the moths have been found only on lands which have been devoted to grass for some years, such as parks, permanent pastures and meadows. They occur on rolling, well-drained, and sometimes rather damp land, either open or with scattering large trees, but never on high or dry knolls. They do not appear to be generally distributed over a district, but seem closely confined to certain small areas varying in size from a few yards to two or three acres. During the early part of their season no moths occur outside these areas, but toward the close of their period of flight they become somewhat more diffused. Observations show that these infested areas remain the same from year to year. For some time no explanation could be offered for this fact but when it was found that the larvæ, especially in the early stages, can subsist only on certain mosses, it appears that the presence of these essential food plants is the factor determining both the abundance and exact distribution of the species.

The moths are easily flushed at any time of day, fly in a rather direct line for four to ten yards and alight abruptly, always head up, sometimes on a broad-leaved plant, but preferably on a grass stem. When blue grass is present they often choose its more or less pendulous heads and when so resting are very inconspicuous. Occasionally moths which have been flushed several times will feign death and often when struck down with a net they remain motionless until touched.

In our collections the males greatly predominate, especially at the first appearance of the moths. Apparently the males emerge somewhat earlier than the females and the following

record of moths taken at Nashville in 1916 by Mr. W. B. Cartwright bears this out:

Date Taken	Total Moths	Male	Female
May 5.....	10	10	...
May 6.....	38	32	6
May 8.....	43	30	13

Of the 38 specimens taken in the field in 1914, 22 were males; of the 118 taken in 1915, 101 were males, and of 94 taken in 1919, 75 were males. Of the total taken in the three years, 79% were males. Felt's (1894) record shows that in 1889 at Ithaca, N. Y., 55 moths were captured in a lantern trap, 26 of them males and 28 females, this being the only one of all the species which he worked where the females captured at light exceeded the males. In our work no trap lights have been operated near where these moths were known to occur. None were taken at light at Nashville, and but one, a male, at Knoxville. We have been unable to verify Felt's statement that the females fly later in the day than the males.

The adults of both sexes are vigorous and live longer in confinement than those of most species. Eighty-four males collected on various dates lived on the average 4.7 days confined in dry 2-dram vials; 21 females under the same conditions averaged 5.8 days. In the open, under normal conditions, the moths of both sexes probably live much longer than this. The sexes are more nearly equal in their vitality than is usual in this group, for in confinement the males of other species usually die very much sooner than the females. One male lived 11 days, which is longer than any female survived.

The great vitality of these moths is also displayed by the fecundity of the females. Felt states that the species is prolific and we have found this to be true, in fact, this is the most prolific species in this genus of which we have any knowledge. His record of "over two hundred" eggs was far surpassed. One moth laid 868 eggs, the largest number obtained from any individual of any species of this genus so far. Others laid 832, and 720, and eight laid over 500 each. The average for



25 moths under observation was 378, an average of 65 eggs per day for the life of the average female. Our records show that the largest number of eggs was deposited usually the first or second night after capture with a gradual decrease in number nightly until the death of the moth. The largest number laid by one moth in one night was 455, but records of 250 were several times obtained. All these moths were confined in dry vials and undoubtedly died somewhat sooner than they would have done under natural conditions, but from results obtained in more extensive experiments with other species it is concluded that the total number of eggs produced would not have materially increased with lengthened life.

The moths follow the usual habit of the genus in dropping their eggs promiscuously while in flight, but it seems that they are not so careful to await nightfall before beginning operations as are many of the other species. Females captured late in the afternoon sometimes dropped several eggs within a few minutes of their capture.

*The larvæ.*—In the first two years of work with this species we were entirely unsuccessful in rearing the larvæ. Great numbers of active, newly-hatched larvæ were placed in the small tin boxes used for rearing other species and supplied with fresh leaves of bluegrass, red and white clover, alfalfa, soy bean, cow pea, wheat, rye, corn, timothy, orchard grass, *Muhlenbergia diffusa*, *Plantago lanceolata* and *Rumex crispus*, all of which they consistently refused to touch. Numbers of larvæ were transferred to potted plants of corn, rye, oats and bluegrass, but later no trace of their having fed could be found. The flora of the various tracts frequented by the moths was minutely studied in an effort to find some plant common to them all. In several such places the stand was apparently pure bluegrass. No empty cocoons or pupal shells were found by digging about plants where the moths were active. Numerous crambid larvæ collected from various places were reared, but none developed into moths of this species.

In the spring of 1916, however, acting on a clue gained from another species, some of the larvæ were put into a box containing among other things, a bit of moss. It was seen almost at once that the larvæ were attracted to the moss. They fed on it to some extent and one or two of the larvæ prepared

to molt to the second instar. None succeeded, however, and all finally died.

The next year the test was repeated, using moss of several different species. The larvæ fed to a slight extent on several of them, but thrived and finally matured on only one, *Thuidium delicatulum* (L.) Mitt. It is very likely that other species are equally as acceptable as this one. After the first instar leaves of bluegrass, corn, cow peas and crabgrass were offered them frequently and as they grew older some of the larvæ fed to a greater or less extent but without showing any marked preference. They continued at the same time to feed on the moss and some of them reached maturity without other food. It was plainly evident that moss is absolutely essential to the young larvæ, as we never succeeded in getting them beyond the first instar without it. In the later instars their appetites are a little more elastic, but even then they do not appear to thrive as well on a diet limited to grasses as when they have a little moss for an appetizer.

As stated above, nothing is known of the behavior of the larvæ in the field for they have never been found under natural conditions. After it was found that they would feed and thrive on moss a number were reared from egg to adult in individual tin boxes. Instar records of some were kept but because of the small number for which the data are complete it is not possible to draw reliable conclusions. It is not easy to get accurate instar records of this species because each larva makes for itself a silken tube or retreat running through the moss mass. To search out and examine the larvæ daily to determine their condition results in the death of most and the abnormal development of the rest. Suffice it to say for the present that larvæ obtained from eggs laid May 17, developed into moths, part of which emerged in the rearing boxes between September 21 and 26. Others were apparently full grown and some in the pupa stage when exposure to an unusually severe frost on November 28, killed them all. The fact that there was such a variation in the period of development in this material showed that the results could only suggest and not prove the usual progress of events. It is evident that it is a very rare occurrence for moths of this species to appear in the fall. In several years collecting we have not known

such a case and the only recorded instances are those reported above from New Jersey and Colorado.

*The egg.*—The eggs when first laid are clear ivory-white. They hatch in 9 to 12 days, depending on the temperature. In one lot of eggs closely observed during the 12 days required for incubation, it was noted that after one day they had become flesh-colored, in two a pale salmon, which, during the third and fourth days slowly deepened to a rich salmon-red and then remained constant until the eleventh day. On the seventh day two small dark eye spots become faintly visible toward one end of the egg, by the eighth day they had become more apparent as small black points within the egg and remained thus until the egg darkened just before hatching. On the eleventh day the head and cervical plate were apparent, the former as a dark area nearly at the end of the egg and the latter as a transverse band close behind it. The dark color of these parts gave a purplish tinge to the whole mass of eggs. On the twelfth day the young larva emerged, effecting escape through an irregularly cut hole at one side of the larger end of the egg. The hole is just at the position on the egg occupied by the head of the larva before hatching, its edge not quite reaching the pole. In this species, as in several others, the egg shell consumed by the larva in effecting its escape from the egg changed to a bright red or orange in the intestinal tract, passed through as a solid plug and was voided as a brightly colored particle just in advance of the first excrement. The empty egg shell is pearly white with an iridescent lustre.

Infertile eggs do not change color and soon shrivel. Some eggs color slightly and then shrivel, indicating that they lack the vitality to develop even though they seem to be fertile. As a rule nearly all eggs hatch, only the last few deposited before the death of the moth being weak or infertile. This leads to the conclusion that the female moths mate but once and from observations on other species this probably takes place shortly after emergence from the pupa.

*The pupa.*—Nothing definite can be said about the cocoon or pupa. The few that were formed in the breeding boxes were enclosed in cocoons of silk and debris with nothing to differentiate them from those of other species.



## DESCRIPTIONS.

*The egg.* Ivory-white, elongate oval, bluntly rounded on both ends, one of which is only slightly the larger, with about 16 longitudinal ribs merging at each end into an irregularly tuberculate polar area, these ribs and the intervals between them crossed by other less prominent ridges of which there are about 18 in the length of the egg. Measurements (10 eggs measured):

	Maximum	Minimum	Average
Length.....	.4413 mm.	.4060 mm.	.4130 mm.
Width.....	.3001 mm.	.2648 mm.	.2718 mm.

*The larva.* Instar I. (Newly hatched). Length 1.15 mm. Head width .1589 mm. Head deep fuscous to black, cervical plate fuscous, body pale orange, the color heightened by the red color of the particle of ingested egg-shell, paler caudad. Head and body with numerous pale slender hairs, those on body arising from small dusky pinacula.

II. Length 1.40, head width .2294 mm. Head black, cervical plate deep fuscous, body reddish brown with a greenish tinge.

III. Length 2.80, head width .3353 mm. Head dark yellow, semi-transparent, unmarked, shining, ocellar area black; cervical plate fuscous, shining, darker than the head; body pale green prominently marked with transverse segmental bands of reddish brown overcolor giving the entire insect a dingy brownish color.

IV. Length 3.5, head width .4235 mm. No marked change.

V. Length 5.9, head width .5118 mm. Head clear dingy yellow, unmarked, ocellar area and narrow lateral margin black; cervical plate transparent, dusky greenish-brown with two or three dusky spots laterally; body reddish brown, pinacula fairly distinct especially on the thorax, somewhat darker than skin and rugose but not sharply defined, moderate in size. Setæ pale and shining.

VI. Length 7.0, head width .7415 mm. Head clear amber-yellow, mouth parts brown, ocellar area and marginal line black; cervical plate glassy, transparent and colorless except for the greenish color from food, a dusky spot toward either end; pinacula prominent, rugulose and chocolate-brown, rather large; skin finely granular, glistening, covered especially caudad with reddish-brown or maroon overcolor through which are small groups of small clear vacuoles along the lateral margin. At a glance the larva appears dark reddish-brown with a clear yellow head.

VII. Length 10.0, head width .9794 mm. Head clear yellow with a row of small dusky points across the face, ocellar area marginal spot and line and mouth parts black; cervical plate transparent, greenish-yellow; body heavily covered with reddish-brown overcolor in which are rows of small clear vacuoles along the dorsolateral margin; skin dull, pinacula feebly shining and rugulose, poorly defined and indicated only by the character of the surface, body paler caudad.

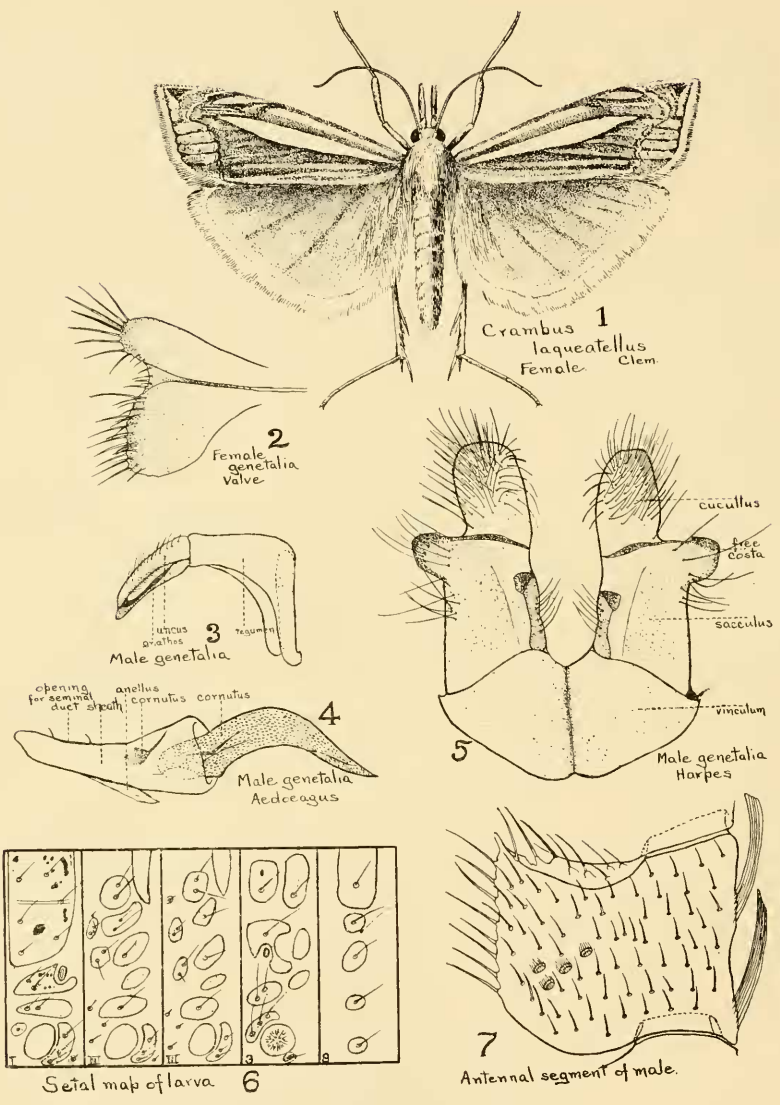


FIG. II.

VIII. Length 14.0, head width 1.2126 mm. Head clear pale yellow; cervical plate transparent with dusky cephalic margin; skin of thorax pale yellow, of abdomen deeply covered with purplish-brown overcolor against which the chocolate-brown pinacula are distinguishable only by the texture of their surface.

IX. Length 15.0, head width 1.4929 mm. Head yellow with a slight brownish tinge and a very faint brownish pattern, clypeus whitish, rest of mouth parts dark brown; ocellar area and marginal spot black; cervical plate clear greenish-yellow with an oval fuscous spot near each end; body color dusky green, darker caudad with the dense dark purple overcolor through which on the caudal two-thirds of the body there are conspicuous rows of large clear vacuoles along the lateral and segmental lines; skin granular, pinacula large, dark purple, shining and feebly rugose; caudal plate dusky with dark points. For relative size and arrangement of the pinacula see (Fig. II, 6.)

*The pupa.* Length 9.0 mm., width 2.8 mm. Dusky yellow, of the usual pyralid shape. Spiracles small but sharply elevated. Cremaster broad, flattened, from above subquadrate, somewhat narrowed caudad with a minute pale seta at each outward angle, the tip narrowed and abruptly depressed, almost tubercle-like, bearing at its extremity a pair of larger dark setæ; lateral grooves shallower and narrower than in most species, only moderately curved; beneath excavated.

*The adult.* The following is Clemens' (1860) original description slightly modified by Fernald (1896). (Fig. II, 1.)

"Expanse of wings 23 mm. Head luteous; thorax and palpi fuscous, the latter whitish beneath. Fore wings ochreous, with two silvery-white streaks separated by a fuscous streak; the outer silvery streak margined on costa with fuscous; the inner one, which extends beyond the apical third, edged on the fold with fuscous. Beneath the fold the wing is pale yellowish with fuscous streaks along the submedian veins. Apex of the wing tinted with ochreous yellow, the veins streaked with silvery white; on the costa near the tip an oblique silvery streak, margined on both sides with fuscous. The subterminal silvery-white line much angulated, bending in below the apex, leaving a large whitish marginal patch streaked with dark parallel lines which end in dots before the terminal line. Fringes lustrous ochreous. Hind wings pale fuscous; fringes white."

The Tennessee specimens agree well with this description but are somewhat larger, averaging 27 mm. in alar expanse. The "whitish marginal patch" is more pale fuscous than white and the "pale fuscous" hind wings are whitish along the margins especially toward the apex.

*Genitalia. Female.* (Fig. II, 2). Anal plate wider than long, somewhat constricted at base, margins serrate with tubercles terminating in long stout spines; the upper third sharply rounded and separated from the rest by a deep rounded notch, lower lobe shorter than the upper, evenly rounded above, slightly angled at lower corner. *Male.* Tegumen (Pl. XII, Fig. 3) with both body and limbs rather narrow and about equal in length the latter slightly narrowed mesad, and rounded

distad. Uncus setigerous, stout, narrowing acutely distad and tipped with a short sharp curved tooth; gnathos naked, slender, exceeding the uncus, at tip widening and the margins upturned forming a pocket into which the tip of uncus fits when closed. Harpes (Fig. II, 5) broad at base, the costa of the harpes proper free but greatly reduced to chitinized angular lobe extending at right angles to the base of the cucullus which is a broad rounded, lightly chitinized process, hairy within and separated from the sacculus by a narrow chitinized carina. Sacculus broad and almost rectangular, slightly concave, sparingly setigerous on both margins with a portion of the inner margin thickened and inturned and terminating in a small rounded lobe. Vinculum a broad subtriangular, weakly chitinized area supporting the sacculi. Aedoeagus (Fig. II, 4) subconical, smaller and rounded at the base, flaring somewhat at the open end, very feebly chitinized, bearing inside about midway a small acute chitinous spine with a broad flat base, and just within the open end and projecting far beyond a huge, heavily chitinized curved, flattened spine longitudinally carinate at the base and covered with minute acute points inclined toward the tip, this spine or cornutus equalling in length the aedoeagus proper. The anellus is a mere membrane attached to the aedoeagus ventrad.

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\*Because of the trivial nature of so many of the references it has been decided unwise to continue the plan outlined in the first paper of this series (Ann. Ent. Soc. Am. 11:51, 1918) and only literature referred to in the text is included in this bibliography.